Engineering Design Report
10 Broad Street Site
Seattle, Washington
Consent Decree No. 01-2-13878-2 SEA

Prepared for
Museum Development Authority

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ENGINEERING DESIGN REPORT
10 BROAD STREET SITE
SEATTLE, WASHINGTON

SECTION 1—INTRODUCTION

This Engineering Design Report (EDR) presents the basis of design for the 10 Broad Street Cleanup Action and has been prepared in accordance with WAC 173-340-400(4)(a). This cleanup action will be conducted by the Museum Development Authority (MDA) as part of a Prospective Purchaser Consent Decree (No. 01-2-13878-2 SEA) negotiated with the Washington State Department of Ecology (Ecology).

Site Description

The 10 Broad Street property is located at the northwest corner of Elliott Avenue and Broad Street along the northern end of the waterfront business district (Figure 1). The property is bounded to the north by the former Unocal Marketing Terminal (Terminal), to the east by Elliott Avenue, to the west by the Burlington Northern Railroad (BNRR) right of way, and to the south by Broad Street. The rectangular property covers a total area of approximately 13,790 square feet and contained an approximately 4,010-square-foot building that was built around 1976 (Figure 2). RC's Billiards Sports Bar and Grill was the last occupant of the recently demolished building. The remainder of the property is paved or covered with decorative landscaping. The property slopes westward toward Elliott Bay.

Prior to 1916, the site was used for residential purposes. From 1916 to 1975, the site was used for welding and/or automobile service operations. Several underground storage tanks (USTs) were present on the property, most in the southeastern corner of the site. Six USTs were to be removed as part of site redevelopment in 1975, but records documenting the removal have not been located. In 1976, the existing building was constructed. Shakey's Pizza operated a restaurant at the site until the mid-1990s when the most recent tenant, RC's Billiards, began operations.

In October 2000, SAM entered into a purchase and sale agreement with Larmar, Inc., Marlene Ivy, and Fortune Real Estate Investments, Inc. for the purchase of the 10 Broad Street property. SAM, in partnership with the City and the MDA, intends to create a public sculpture park on the property and the adjacent site of the former Unocal Terminal. The sculpture park will include sculptures, pedestrian trails, and landscaped open space. The 10 Broad Street site will provide safe pedestrian access between the sculpture park and the public waterfront. At this time, there are no plans to install permanent heated building structures on the 10 Broad Street property.

EDR Organization

The EDR provides detailed analysis of remedial components discussed in the Cleanup Action Plan (CAP) developed for the project (Hart Crowser 2001b). The CAP was preceded by a Remedial Investigation/Feasibility Study (RI/FS) (Hart Crowser 2001a) which identified contaminant issues and potential remedial options for the site. The site characterization data and contaminant assessment presented in the remedial investigation and CAP have not changed and are therefore not updated in this EDR document.

The EDR consists of the following sections:

Section 1—Introduction

The introduction (this section) presents the purpose, general background, and organization of the report.

Section 2—Cleanup Requirements

Section 2 presents the cleanup requirements or goals of the project, including cleanup levels and remediation levels.

Section 3—Basis of Design

Section 3 presents the basis of design for the project, including engineering concepts, criteria, and calculations. The supporting design memoranda and narratives prepared during the design development stage of the project are included as appendices.

Section 4—Compliance Monitoring Plan

The compliance monitoring activities to be followed during and following remediation are presented in Section 4. Compliance monitoring is performed to confirm that the cleanup action has attained the cleanup requirements prescribed by the cleanup plan. The CMP was prepared in accordance with WAC 173-340-410.

No Operation and Maintenance Plan was developed because the remedial action does not involve operation of a treatment system.

Section 5—Schedule

The schedule for remediation is presented in Section 5. Remedial activities shall be completed within a reasonable time frame in accordance with WAC 173-340-360(6).

SECTION 2—CLEANUP REQUIREMENTS

Cleanup Levels

Cleanup levels for the chemicals of concern identified in 10 Broad Street soils and groundwater, including petroleum hydrocarbons and volatile aromatics, are presented in Table 1. Soil and groundwater cleanup levels were developed based on the proposed recreational land use of the site and the determination by Ecology that there is no current or planned future groundwater use as a drinking water source. The highest beneficial use of the site groundwater is protection of the adjacent surface waters and its ecosystems. Cleanup levels are designed to prevent petroleum vapors from adversely impacting ambient air, and to prevent elevated dissolved petroleum hydrocarbon concentrations in groundwater from migrating off site.

Soil

Cleanup levels for soil are presented in Table 1 and are based on MTCA Method B residential soil cleanup levels for the direct contact pathway and Method A residential (unrestricted) cleanup levels for soil to groundwater and soil to air pathways. A site-specific direct contact cleanup level for non-carcinogenic petroleum hydrocarbons may be established based on fraction-specific hydrocarbon testing as part of the remediation compliance monitoring program. The hazard quotient for the direct contact pathway shall not exceed 1 under a residential exposure scenario using procedures outlined in WAC 173-340-740(3).

Compliance groundwater and ambient air monitoring results will ultimately be used to evaluate compliance with soil to groundwater and soil to air pathways (Table 1). If confirmation groundwater monitoring results are in compliance with groundwater cleanup standards applied to the site for four consecutive quarters, site soil quality will be considered adequately protective of the soil to groundwater pathway. In the event that groundwater monitoring results indicate that contaminated groundwater exceeding surface water criteria is migrating off property and threatening the adjacent marine surface water body (Elliott Bay), and Ecology issues a written determination that contingency remedial actions are necessary, a remedial action plan will be developed to address soils exceeding residential soil cleanup levels.

Confirmation that soil hydrocarbon concentrations are protective of human health and the environment for the soil to ambient air pathway will be based on compliance with ambient air cleanup standards. If confirmation ambient air monitoring results are in compliance with air cleanup standards presented in Table 2 during the two post-remediation sampling events described in Exhibit F to the Consent Decree, site soil quality will be considered to be adequately protective of the soil to ambient air pathway.

Groundwater

Because site groundwater discharges into the adjacent marine surface water body and is not likely a current or potential source of drinking water due to elevated salinity, groundwater quality data are compared to Method B surface water criteria (including Washington State surface water quality standards – Chapter 173-201 WAC). Because there are no established Method A or B surface water criteria for total petroleum hydrocarbons (TPH), screening levels for TPH are based on Method A drinking water cleanup levels (Table 1).

Air

Cleanup levels for ambient and indoor air are based on MTCA Method B cleanup levels (Table 2). In cases where no Method B criteria are available, the Puget Sound Clean Air Agency (PSCAA) Acceptable Source Impact Levels (ASILs) were used. Since no Method B or PSCAA criteria have been established for TPH, Method B air cleanup levels were calculated for each of the petroleum equivalent carbon (EC) fractions identified in the MTCA regulation.

Inhalation reference doses used to calculate Method B cleanup levels for these hydrocarbon fractions were obtained from "Ecology Guidance Calculation of TPH Human Health Direct Contact Cleanup Levels Using Default Compositions," which was presented to the Science Advisory Board by Steve Robb in January 1999. Since no inhalation reference doses were available for the EC 3 to EC 5 range and the EC 12+ range, no cleanup levels were calculated for these fractions.

SECTION 3—BASIS OF DESIGN

This section describes geotechnical and environmental design elements supporting the Cleanup Action Plan for the 10 Broad Street site, and the basis and development of the design. The main engineering design components of this project are the removal of "RC Billiards" building foundation, construction of a temporary shoring wall along Elliott Avenue, and excavation of the impacted soils to appropriate depths and lateral extents.

In this section, we discuss the expected sequence of construction, and provide design criteria and parameters to be used for remedial construction activities.

Anticipated Construction Sequence

To remove petroleum-impacted soils to a depth of 18 feet or more at the 10 Broad Street site and avoid a potentially expensive dewatering system, the sequence of construction will be as follows:

- Site preparation, including foundation demolition, pavement removal, and brush clearing (as needed within the excavation footprint);
- Soldier pile drilling and installation;
- Mass excavation, using 2H:1V slopes or flatter for north, south, and west excavation boundaries;
- Installation and testing of tiebacks and installation of lagging between soldier piles on the east side of the excavation, using appropriate cuts for conditions encountered;
- Staging of mass excavation:
  - Excavate to a practical excavation depth above the groundwater surface as discussed above; and
  - Excavate to the final maximum practical depth at low tide and immediately begin backfilling;
- Backfill to a level about 4 feet below planned grade using general backfill (either reused excavated soils or import soils), compacted to 90% ASTM D 1557 (moisture content within 2% of optimum), placed in 12-inch lifts; and
- Backfill remaining 4 feet using select fill compacted to 95 percent of ASTM D 1557 (moisture content within 2% of optimum), also using 12-inch lifts. Select fill will comply with City of Seattle Type 17, or equivalent.

As mentioned in the Exhibits to Consent Decree (Hart Crowser, March 28, 2001), no structures are presently planned for the 10 Broad Street site. Actual backfilling requirements should be updated prior to construction based on the most recent planning for the components of the Sculpture Park that will reside on the site. The current backfilling scheme would provide adequate support for shallow foundations for light sculptures and heavier sculptures with appropriately sized footings or deep pile foundations, depending on the applied loads.

Site Preparation

Features such as brush, pavement, and foundation elements (e.g., footings and piles) shall be removed. The entire concrete building foundation and the asphalt parking lot will be removed. Debris produced from demolition will be disposed of at a solid waste landfill.

Anticipated Subsurface Conditions

The site is located in the Puget Sound Lowland physiographic province of Washington State on a southwest-facing hillside along Elliott Bay. Soils beneath the site to a depth of approximately 10 to 15 feet are predominantly silty sand and silt fill materials with occasional brick or wood debris. Underlying the fill layer are beach sands (primarily on the western half of the site) and sandy or silty sandy outwash deposits to an approximate depth of 25 feet. Very dense glacial till underlies the outwash.

Unconfined groundwater is encountered in the fill unit throughout most of the site at depths ranging from 10 to 15 feet. Groundwater generally flows to the west or northwest toward Elliott Bay except during periods of high tide, when flow is temporarily reversed. The net groundwater flux is toward Elliott Bay.

The existing explorations in the area of the RC Billiards building were performed primarily to determine the nature and extent of soil and groundwater contamination at the project site. Hart Crowser installed an additional geotechnical exploration (HC-1) at the location of the shoring wall to evaluate physical soil conditions in this area. Based on data collected from this exploration, soil conditions in the shoring wall area consist of:

- **Sandy, Gravelly CLAY.** This soil unit is generally medium stiff to stiff in consistency. These soils contain woody debris and other organics, and are present to a depth of about 15 feet.

- **SAND and GRAVEL.** Beneath the sandy clay, slightly silty to very silty sand and gravel were encountered. This soil unit is very dense, with the exception of the upper 2 to 3 feet, which is medium dense. The sand and gravel extends to the bottom of the exploration, with increasing silt content at the bottom of the boring.

Based on explorations around and on the project site, the top of the dense sand and gravel layer slopes down toward the water, and is located about 18 feet below ground surface (elevation –5 feet, City of Seattle datum) on the east end of the site.

As discussed above, groundwater around the site has been measured at depths generally ranging from about 10 to 15 feet below ground surface. The range in measured depths around the site reflects the influence of tidal fluctuation in Elliott Bay, and may be somewhat "time-lagged" behind the actual tide level changes. Along the east side of the 10 Broad Street site, monitoring wells checked throughout the tidal cycle showed a depth of about 16.5 feet (elevation –3.5 feet, City of Seattle) to water, with little influence from the tide. Prior to construction, newly installed or existing wells should be checked again to determine the relationship between the tidal fluctuation and the actual groundwater fluctuation so that the timing of the excavation is appropriate. In developing the shoring wall design, it is assumed that groundwater on the uphill (retained) side of the temporary shoring wall will not respond to tidal fluctuations as quickly as groundwater in the excavation, and thus the shoring wall has been designed for an unbalanced head of 3 feet. This represents the difference between the measured highest groundwater level in nearby wells (plus about 1.5 feet), and the planned bottom of the excavation at a depth of 18 feet.

Temporary Shoring Wall Design and Construction

To excavate to the planned depth immediately adjacent to Elliott Avenue, a temporary shoring wall will be necessary (Figure 3). The shoring wall will consist of vertical I-beam elements (soldier piles) with wood lagging installed between them as excavation proceeds. Tieback anchors will be advanced into the retained soil and tied into the soldier piles to provide additional restraint. A registered structural engineer will design the temporary shoring wall based on earth pressure diagrams and tieback adhesion values provided by Hart Crowser (Appendix A).

Two major soil units (discussed in greater detail above) were encountered during geotechnical exploration for the project. Table 3 provides the geotechnical engineering parameters that were used for the design of the shoring wall.

Stability of Temporary Slopes above and below the Groundwater Surface

The excavation will extend below the groundwater surface. Much of the monitoring around the site suggests that the groundwater elevation fluctuates with the tide, with an average change of about 5 feet between high tide and low tide. In the area of the shoring wall, the fluctuation may be much more limited.

An important aspect for the stability of temporary slopes is to avoid having to excavate, handle, and dispose of an additional volume of soil sloughing into the excavation during mass excavation. This is especially important for the last stage of excavation. Though the water level will have responded to low tide, the soils may still have higher pore pressure in the slope which could result in lower soil strength.

In general, temporary slopes will be limited to 2H:1V or flatter to reduce risk of loss of ground during mass excavation. The loose granular soils will undergo sloughing and/or surficial raveling during the excavation process. This would most likely occur below a depth of 10 feet where soils are wet to saturated. We expect that some sloughing of soils near the toe of the slope will occur as materials are removed below the groundwater surface. This sloughing could require additional excavation volume beyond that planned for the project, and may result in an overall slope that is flatter than planned. To reduce the potential for sloughing, final excavation below the groundwater surface will be performed during times of the lowest tides to the extent that this is practical.

Soldier Pile Shoring System Construction

Soldier pile shoring system construction may be made difficult by the presence of loose fill material in the excavation and the relatively high groundwater surface. Some caving of site soils may occur during both tieback and soldier pile installation. Therefore, cased drilling methods and/or the use of slurry techniques may be required.

We also anticipate that some raveling of the upper fill soils and lower sands and gravels could occur. Lagging will be placed in small vertical increments, if necessary, and voids produced behind the shoring system due to loss of ground will be backfilled with free-draining backfill during construction. Prompt and careful installation of lagging particularly in areas of seepage and loose soils is important to maintain the integrity of the excavation. The shoring contractor will be responsible for proper installation to prevent soil failure, sloughing, and loss of ground, and to provide safe working conditions.

Extent of Remedial Excavation

Soil on the 10 Broad Street property containing TPH and BTEX concentrations above cleanup levels listed in Table 1 will be excavated as practicable. The estimated area and depth of the excavation, based on existing data and site constraints, is described below and shown on Figure 3. As part of this remedial design process, a field investigation was conducted to determine the extent of contamination under the RC's Billiards building footprint. The scope and results of this field investigation are presented in Appendix B. Results of this testing indicated that the extent of soils exceeding petroleum cleanup levels is primarily limited to the southeastern corner of the building footprint.

The extent of the soil excavation may change based on results of field screening and verification sampling and analysis during construction. The eastern excavation boundary will be the shoring wall along Elliott Avenue. The western, northern, and southern boundaries of the excavation will be determined by the extent of contamination and by limitations arising due to groundwater conditions or sloping requirements. The vertical excavation extent will likely be limited by the practicability of excavating below the water table.

Because some excavation will occur below the groundwater surface, we expect there will be surficial sloughing in areas as the excavation proceeds. Soil conditions encountered during excavation must be evaluated so that measures necessary to ensure worker safety during construction are taken. A partial list of methods to reduce the potential for sloughing includes:

- Localized dewatering may be used to maintain stable slopes in areas where more granular materials are present.

- Cut slopes may be protected with plastic, and/or looser areas may be excavated using smaller, staged slotted cuts.

- Portions of the excavation may be stabilized using quarry spalls or other heavy, high strength material as slope protection.

- The slope face may be covered with a protective barrier, such as anchored chain link fence, to prevent large cobbles and boulders from raveling down the slope face.

Alternative methods for reducing sloughing at the cut face may be identified. All work will be completed in accordance with applicable local, state, and federal laws and regulations.

Field Screening

Excavated soils will be stockpiled separately based on field screening. Field screening will provide a cost-effective method for characterizing the soils in a timely manner. Excavated soils will be inspected for petroleum sheens, staining, or odor. The headspace of excavated soils will be monitored for organic vapors with a photoionization detector (PID). In general, one soil sample will be collected for field screening every 10 to 20 feet laterally in two directions and every 2 to 4 feet vertically. If field screening indicates that the extent of contamination may have been reached, verification samples will be collected and analyzed as described in Section 4.

Soil Management

Clean and contaminated soils and debris will be excavated. Depending on constituent concentrations, excavated soils will be used as backfill or transported off site for treatment or landfilling. This section specifies soil stockpile segregation, sampling, laboratory analysis, and waste designation procedures to be used for this project.

Soil Stockpile Segregation

We expect approximately 1,200 cubic yards of contaminated soil and 4,300 cubic yards of clean soil will be excavated. These estimates are based on the contaminant distribution presented in the RI and the expected cut of the excavation.

To isolate potentially contaminated soils from non-contaminated soils, soils shall be segregated, stockpiled, and tested based on their origin and the results of field screening. Soil stockpiles will be placed on the adjacent Former Unocal Lower Yard in areas delineated on Figure 3. The maximum stockpile size will be 500 cubic yards. Stockpiles shall be constructed to isolate stored contaminated material from the environment including:

- A chemically resistant bottom geomembrane liner. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 pounds per 1,000 square feet. The ground surface on which the geomembrane is placed shall be free of rocks greater than 0.5 inch in diameter and any other object that could damage the membrane.

- Geomembrane cover to prevent precipitation from entering the stockpile. Non-reinforced geomembrane liners shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 26 pounds per 1,000 square feet. The cover material shall be anchored to prevent it from being removed by wind.

- Berms shall be constructed around stockpiles that contain soil saturated with water. Berms shall also be constructed to prevent stormwater from entering soil stockpiles. Berms surrounding the stockpile shall be a minimum of 12 inches in height.

- Liquid that collects in the stockpiles shall be removed, temporarily stored, and disposed of. If possible, stockpile liquids shall be combined with water removed from the excavation for storage and disposal.

The following soil classifications shall be segregated for testing:

Potentially Contaminated (PC) Soils. PC soils consist of material excavated from above the water table (a depth of approximately 10 to 15 feet) for which field screening indicates the likely presence of TPH or BTEX at concentrations above cleanup levels (e.g., strong odor, staining, sheen, or high PID readings). The estimated volume of PC soils is 600 cubic yards.

Potentially Marginally Contaminated (PMC) Soils. PMC soils consist of material excavated from above the water table for which field screening indicates the likely presence of TPH or BTEX at concentrations below cleanup levels (e.g., faint odor or low PID readings). The estimated volume of PMC soils is 600 cubic yards.

Potentially Contaminated, Wet (PCW) Soils. PCW soils consist of material excavated from below the water table. We anticipate that all soil removed from below the water table will be contaminated. The estimated volume of PCS soils is 500 cubic yards.

Potentially Non-Contaminated, Geotechnically Suitable (PNCS) Soils. PNCS soils consist of soils excavated above the water table for which field screening indicates no evidence of TPH or BTEX contamination and which conform to the fill standards listed in the ***Excavation Backfill*** section. The estimated volume of PNCS soils is 4,300 cubic yards.

Potentially Non-Contaminated, Geotechnically Unsuitable (PNCU) Soils. PNCU soils consist of soils excavated above the water table for which field screening indicates no evidence of TPH or BTEX contamination but which do not conform to the fill standards listed in the ***Excavation Backfill*** section. We expect a minimal amount of PNCU soils will be generated.

Soil Designation Sampling

Soil will be excavated and temporarily stockpiled on field screening until designation samples can be collected, analyzed, and the results confirmed with the contractor. The stockpile soil sampling frequency will be based on Ecology guidance calling for three samples for up to 100 cubic yards of stockpiled soil and five samples for up to 500 cubic yards. The appropriate number of samples will be determined in the field based on a visual estimate of stockpiled soil volume and homogeneity.

Each stockpile designation soil sample will be a representative, discrete, grab sample collected from a depth of at least 12 inches beneath the surface of the stockpile and placed in a cooler for transport to the laboratory under chain of custody protocols. The sampling equipment will be decontaminated between sampling events to prevent cross contamination.

Soil samples will be analyzed for the following constituents:

- Gasoline-range petroleum hydrocarbons by Method NWTPH-G;

- Diesel- and oil-range petroleum hydrocarbons by Method NWTPH-Dx; and

- BTEX by EPA Method 8021 or 8260.

Soil Disposal

Excavated soil will be disposed of as follows:

- Soil that contains constituents above cleanup levels will be disposed of at a suitable permitted landfill or soil recycling facility;

- Soil that contains constituents below cleanup levels and meets geotechnical requirements for on-site fill (see the ***Excavation Backfill*** section) will be used to backfill the excavation. Soil may also be used as fill on the Lower Yard or Upper Yard if geotechnically suitable; and

- Soil that contains constituents below cleanup levels but does not meet geotechnical requirements for on-site fill will be disposed of off site or on the Lower Yard if it meets area-specific geotechnical requirements

Investigation-Derived Waste Drum Disposal

Two drums containing soil cuttings and one drum containing well purge and development water from investigations on the 10 Broad Street property are stored on the adjacent Former Unocal Lower Yard parcel. Soil and water in these drums will be combined with contaminated soil and water removed during the excavation and disposed of as contaminated material.

Dust and Erosion Control

Fugitive emissions of soil or solid materials during on-site activities shall be prevented. No visible dust shall be generated. Soil erosion due to precipitation runoff or run-on to or from excavations, stockpiles, paving areas, or other soil areas exposed or disturbed by construction activities shall be controlled using berms, surface water control, straw bales, temporary visqueen covers, or other appropriate measures. Provisions shall be made for adequate drainage to prevent accumulation or ponding of non-contaminated run-on/runoff in surface areas affected by construction.

Water Management

The excavation may extend below the groundwater surface. Excavation will generally be done in the wet to minimize side wall sloughing, but limited dewatering may be performed to assist excavating and shoring activities. Water accumulating at the base of the excavation will be pumped out as needed and stored in tanks for profiling and disposal. Because groundwater will likely be contaminated with TPH and BTEX, it will be disposed of either through an appropriate waste disposal facility or discharged to the sanitary sewer. The requirements for discharge of contaminated groundwater to the City sanitary sewer are provided in Appendix C.

UST Removal

Up to six USTs are known to have been present at the site in the past. It is not known whether these tanks have been removed or closed in-place. If tanks are encountered during the excavation, an International Fire Code Institute-licensed assessor and decommissioner will remove them. Protocols established under the following regulations and guidance documents will be used for removal or closure of site USTs:

- Washington State UST Regulations (Chapter 173-360 WAC);
- Ecology (1992) Guidance for Site Checks and Site Assessments for Underground Storage Tanks 90-52; and
- Applicable OSHA Confined Space Regulations and Guidance Criteria.

These criteria apply to potential USTs if discovered during the course of the site work. A UST closure checklist is provided in Appendix D for planning purposes. Ecology currently requires a 30-day notification period prior to removal of regulated USTs, but may approve closure on an expedited basis. A City of

Seattle Fire Department application must also be submitted prior to removal of site USTs, including fuel oil USTs. Copies of the Ecology notification and Fire Department application forms are provided in Appendix D.

Backfilling the Excavation

The backfill used to fill the excavation will be subdivided into two components, as follows:

- **General Backfill.** This material will be used to fill the excavation to within 4 feet of the final surface elevation and will be compacted to 90 percent of its maximum dry density.

- **Select Backfill.** This material will be used to fill the upper 4 feet of the excavation, and will be compacted to 95 percent of its maximum dry density. Because of the higher compaction specified for this backfill, a more "select" material would be necessary than is used for the General Backfill. Select Backfill will conform to City of Seattle Type 17 or equivalent on-site material if it is encountered during excavation.

Reuse of Site Soil

Excavated soil will be segregated and stockpiled on the adjacent Former Unocal Lower Yard property based on visual inspection and monitoring (i.e., field screening). For those soils that are confirmed to be below cleanup levels through laboratory testing, the soils may be reused as general backfill on site if weather and the nature of the material permits. Non-impacted excavated soils will be used as either General Backfill or Select Backfill, provided that the specified compaction can be achieved with the reused material, and that the reused material is free of organic matter and other debris.

Soil with more than about 5 percent fines cannot be consistently compacted to a dense and non-yielding condition when the moisture content is significantly above or below the optimum. Note that only import sand and gravel fill with less than 5 percent fines is specified for the initial backfilling process until a backfill elevation that will not be repeatedly influenced by tides has been achieved. This will avoid delays with the contractor having to rework/recompact site fill that is wet.

The sandy, gravelly clay soil that is present to a depth of about 15 feet may not be suitable for use as Select Backfill because of its high fines content and the presence of debris. However, it is likely suitable as General Backfill because of the less stringent compaction requirements for this material. The reuse of on-site soils as Select Backfill will only be attempted if the work will be done during extended periods of dry weather so that these materials can be properly moisture-conditioned and recompacted.

Import Soil

Import structural fill may be needed if excavated soils contain debris or are not sufficiently compactable as backfill. A clean, well-graded sand and gravel with less than 5 percent by weight passing the No. 200 sieve, based on the minus 3/4-inch fraction (such as City of Seattle Type 17 material), will be specified for import fill. Less select material may be used during periods of extended dry weather provided compaction requirements are met.

Applicable Permits

We anticipate the following permitting requirements will need to be addressed as part of the cleanup action:

- Approval from the City of Seattle Department of Construction and Land Use (e.g., a street-use permit, shoring permit, and/or grading permit), for construction of the shoring wall and any excavation activities requiring a wall steeper than 1H:1V to the nearest public property (e.g., the Elliott Avenue sidewalk). A separate grading permit may not be required if grading activities are authorized in a street-use permit per Seattle Municipal Code (SMC) Section 22.804.030.

- A minor discharge authorization from the King County Industrial Waste Program for sewer discharges of water collected during the excavation.

Because the work is being managed under an Ecology consent decree, a shoreline permit is not required. However, all work must comply with the substantive requirements of Chapter 90.58 RCW, Chapter 173-26 WAC, and the local shoreline master program. Likewise, even though the project is exempt from a grading permit, the work must comply with the substantive requirements of SMC Chapter 22.804.

SECTION 4—COMPLIANCE MONITORING PLAN

This section presents a summary of the compliance monitoring to be performed during the 10 Broad Street Cleanup Action. The following types of compliance monitoring will be performed:

- **Protection Monitoring** to confirm that human health and the environment are protected during remediation;

- **Performance Monitoring** to confirm that remediation has attained the cleanup standards prescribed by the cleanup plan; and

- **Confirmational Monitoring** to confirm the long-term effectiveness of the remedial action.

Compliance monitoring will be performed as described below in a manner consistent with WAC 173-340-410 and the Consent Decree.

Planned Protection Monitoring Activities

Protection monitoring for human health will be implemented by ensuring that site workers are appropriately trained in health and safety and following a site-specific health and safety plan. Access to the site shall be controlled by security fencing.

Protection monitoring for the environment will include appropriate excavated soil and debris management as described in Section 3. Stockpiles that may contain contaminated materials will be stockpiled and screened in the designated stockpiling area that has appropriate contact and runoff controls. In addition, placement of the stockpiles will be conducted in a manner to ensure protection of human health and the environment (e.g., minimize dust generation).

Planned Performance Monitoring Activities

Performance monitoring will be conducted through the following activities:

- Field Screening;

- Post-Excavation Side Wall and Bottom Sampling and Analysis;

- Stockpile Characterization; and

- Wastewater and Decontamination Water Characterization.

General Monitoring Guidelines

Field personnel will use consistent sampling techniques and documentation protocol while executing this work. Soil sampling will be completed using stainless steel equipment that has been decontaminated between samples. The decontamination process will consist of a detergent wash, tap water rinse, and deionized (DI) water wash-down. Samples will be collected in laboratory-supplied jars and held in coolers with ice pending laboratory delivery. All samples will be transported to the chemistry laboratory in accordance with chain of custody protocols.

Field documents will include a daily stockpile location diagram, a sample location diagram, chain of custody, health and safety monitoring data, and a narrative field report.

Data packages will be checked for completeness upon receipt from the laboratory to ensure that sample data and QA/QC information requested are present. A cursory level of review will be made considering the following:

- Holding times;
- Surrogate spike results;
- MS/MSD or MS/duplicate results;
- Method blanks; and
- Detection limits.

A summary of sample collection procedures, frequency, and methods of analysis is presented below.

Field Screening

Field screening during the excavation will be conducted as described in Section 3. A minimum of two samples collected for field screening per day will also be analyzed for petroleum hydrocarbons by Methods NWTPH-G and NWTPH-Dx and for BTEX by EPA Method 8021 or 8260. Laboratory results will be used to confirm the accuracy of designations based on field screening procedures. Laboratory samples will be analyzed on a 24- to 48-hour turnaround time.

Post-Excavation Side Wall and Bottom Sampling and Analysis

When field screening indicates that all accessible contaminated material has been removed, chemical verification samples will be collected. The number and location of verification samples will be based on the size of the excavation and the most likely locations of contaminated material (based on field screening results). One sample will be collected for every 20 linear feet of side wall at the depth of greatest potential for contamination, based on field observations (likely near the top of the water table). Verification samples will be analyzed on a 24- to 48-hour turnaround time to expedite further excavation (if required) or backfilling. If contamination is observed that must be left in place (e.g., along the Elliott Avenue sidewall), samples will be collected and analyzed to document the observed conditions. Samples will be analyzed for petroleum hydrocarbons by Methods NWTPH-G and NWTPH-Dx and for BTEX by EPA Method 8021 or 8260.

Stockpile Characterization

The stockpiles will be sampled at the appropriate frequency specified in Section 3. Stockpile samples will be analyzed for petroleum hydrocarbons by Methods NWTPH-G and NWTPH-Dx and for BTEX by EPA Method 8021 or 8260. Based on the results of chemical testing, stockpiles will be appropriately treated or disposed of as described in Section 3.

Wastewater and Decontamination Water Characterization

Dewatering of excavations may occur during site activities as discussed in Section 3. In addition, decontamination water from site activities will be combined with site wastewater. Characterization of the wastewater may be required prior to disposal. At a minimum, water samples will need to be analyzed for TPH, BTEX, and total suspended solids (TSS). Other sampling requirements may be imposed upon issuance of a sewer discharge permit. The requirements for the daily limits to the sanitary sewer systems are presented in Appendix C.

Planned Confirmational Monitoring Activities

Confirmational monitoring will be limited to groundwater and air sampling and analysis after construction to ensure that removal of contaminated soils effectively protects groundwater quality.

Groundwater sampling and analysis for confirmation monitoring will be conducted in accordance with the 10 Broad Street Cleanup Action Plan (Hart Crowser 2001b). Details of the confirmational monitoring program are presented in Exhibit F of the CAP. A summary of collection procedures, frequency, and methods of analysis is presented below. If confirmational monitoring indicates remedial action objectives have not been met, contingency actions will be implemented in accordance with Exhibit F of the 10 Broad Street CAP.

Groundwater Monitoring

Groundwater monitoring will be performed in three monitoring wells: MW-5, MW-7, and MW-42. Well locations are shown on Figure 4. Groundwater quality monitoring will be conducted every three months following completion of the cleanup activities until compliance with cleanup levels has been demonstrated for four consecutive monitoring events.

Groundwater samples will be collected using low-flow sampling techniques to minimize suspended solids in the samples. Depth to groundwater measurements will be made prior to sampling to assess groundwater flow directions. The wells will be purged and sampled with a peristaltic pump. Temperature, pH, conductivity, and dissolved oxygen will be measured in the field. Clean sample tubing will be used for each well and disposed of after use.

Groundwater samples will be sent to a laboratory for analysis for the following:

- Gasoline-range petroleum hydrocarbons by Method NWTPH-G;
- Diesel- and oil-range petroleum hydrocarbons by Method NWTPH-Dx; and
- BTEX by EPA Method 8021 or 8260.

Monitoring wells will be maintained until the post-remediation groundwater compliance monitoring program is completed. Upon receiving Ecology approval to discontinue groundwater monitoring, the monitoring wells will be abandoned in accordance with Chapter 173-160 WAC.

Ambient Air Monitoring

Two rounds of ambient air monitoring will be performed to confirm that the remedial action is sufficiently protective of human health relative to the ambient air pathway. The first round of sampling will be performed under warm weather conditions during the 2002 summer or early fall season. Sampling will be conducted on a relatively warm dry day exhibiting low wind speeds. The second round of sampling will be performed in the mid- to late 2002 fall season before heavy rains decrease the air-filled porosity in site soils. Sampling will be collected on a day where wind speeds are minimal and a low pressure system is present.

Two 8-hour composite air samples will be collected using SUMMA canisters. Proposed sampling locations are shown on Figure 5. One upwind and two urban background 8-hour composite air samples will also be collected to establish area background conditions. Potential urban background sampling locations include the downtown Seattle Art Museum location, the Westlake Center, or the Seattle Center.

Samples will be submitted for analysis of petroleum hydrocarbons using EPA Method TO-14A. The analyte list is presented in Table 4.

Compliance with the ambient air remedial action objective will be determined as follows:

- Site ambient air concentrations must meet MTCA Method B cleanup levels; or

- Site ambient air concentrations must be below or equal to area background concentrations.

SECTION 5—SCHEDULE

The 10 Broad Street remedial construction is scheduled to be completed during the summer of 2002. Anticipated dates for future project milestones are as follows:

Finalize Remedial Design Documents	April 19, 2002
Conduct 30-day Public Comment on Remedial Design	April 26, 2002
Issue Construction Bid Solicitations	June 3, 2002
Finalize Remedial Design Documents	June 7, 2002
MDA Approval of Contractor Pre-Job Submittals	July 1, 2002
Contractor On-Site Mobilization/Begin Construction	August 16, 2002
Complete Excavation Construction	September 20, 2002
Complete Contractor On-Site Demobilization	September 27, 2002
Perform Low Pressure Ambient Air Monitoring	November/December 2002
Perform Dry Season Ambient Air Monitoring	July/August 2003

Begin Quarterly Groundwater Monitoring	December 2002/January 2003

See Exhibit C of Consent Decree for additional post-remediation schedule information.

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Table 1 - Proposed Cleanup Criteria for Detected Constituents in Soil and Groundwater

Constituent	Proposed Cleanup Level
Groundwater in ug/L	
Benzene	43 [a]
Toluene	48,500 [a]
Ethylbenzene	6,910 [a]
Xylenes	16,000 [a]
Gasoline-Range Hydrocarbons	1,000 [b]
Diesel-Range Hydrocarbons	1,000 [b]
Oil-Range Hydrocarbons	1,000 [b]
Free Product	No Sheen [c]
Soils in mg/kg	
Benzene	34.5[d]/0.5[f]
Toluene	16,000[d]/40[f]
Ethylbenzene	8,000[d]/20[f]
Xylenes	160,000[d]/20[f]
Gasoline-Range Hydrocarbons	TBD[e]/100[f]
Diesel-Range Hydrocarbons	TBD [e]/2,000[g]
Oil-Range Hydrocarbons	TBD [e]/2,000[g]

Notes:

TBD – To be determined

[a] Based on MTCA Method B surface water cleanup level

[b] Based on MTCA Method A drinking water cleanup level

[c] Although no free product has been encountered at the site to date, the no sheen criteria will be applicable to the area beneath the building where no groundwater quality data have been collected

[d] Direct contact cleanup levels based on Method B residential criteria

[e] Direct contact cleanup levels for non-carcinogenic petroleum hydrocarbons will be based on achieving a hazard quotient of 1 under a residential exposure scenario using procedures outlined in WAC 173-340-740(3).

[f] Soil to groundwater and soil to air cleanup levels based on Method A residential criteria. Confirmation that soil concentrations are protective of the soil to groundwater and soil to air pathways will be based on compliance with groundwater and ambient air cleanup standards. If these pathways are not in compliance, additional remedial actions may be implemented to address soils exceeding these Method A soil cleanup levels.

[g] Soil to groundwater cleanup levels for diesel- and oil-range hydrocarbons are based on residual saturation criteria in accordance with the Interim TPH Policy.

Table 2 - Proposed Cleanup Levels for Constituents of Potential Concern in Air

Compound	MTCA Method B in ug/m^3
Benzene	0.259
Toluene	183
Ethylbenzene	457
m,p-Xylene	320
o-Xylene	320
1,3,5-Trimethylbenzene	420[a]
1,2,4-Trimethylbenzene	420[a]
Propylene	---
1,3-Butadiene	0.00417
Hexane	91.4
Cyclohexane	3400[a]
4-Ethyltoluene	---
Heptane	5,500[a]
Napththalene	170[a]
C3 to C5 Aliphatic Hydrocarbons	---
C5 to C6 Aliphatic Hydrocarbons	9,120
C6 to C8 Aliphatic Hydrocarbons	9,120
C8 to C10 Aliphatic Hydrocarbons	136
C10 to C12 Aliphatic Hydrocarbons	136
C12+ Aliphatic Hydrocarbons	---
C6 to C8 Aromatic Hydrocarbons	---
C8 to C10 Aromatic Hydrocarbons	80
C10 to C12 Aromatic Hydrocarbons	80
C12+ Aromatic Hydrocarbons	---

[a]PSCAA Acceptable Source Impact Level (ASIL) used as no Method B criterion exists for this constitutent.

Table 3 – Geotechnical Engineering Parameters for Shoring Design

Soil Description	Total Unit Weight in pcf	Friction Angle in degrees	Cohesion in psf	Equivalent Fluid Weight for Active Pressures in pcf	Equivalent Ultimate Fluid Weight for Passive Pressures in pcf
Sandy, gravelly CLAY	120	20	100	42	-
Dense SAND and GRAVEL	135	38	0	18*	300

* Active pressure fluid weight based on submerged unit weight of soil.

Table 4 - Analyte List for Ambient Air Monitoring

Compound	Detection Limit Goals in ppbv
Benzene	0.50
Toluene	0.50
Ethylbenzene	0.50
m,p-Xylene	0.50
o-Xylene	0.50
1,3,5-Trimethylbenzene	0.50
1,2,4-Trimethylbenzene	0.50
Propylene	2.0
1,3-Butadiene	2.0
Hexane	2.0
Cyclohexane	2.0
4-Ethyltoluene	2.0
Heptane	2.0
Napththalene	50
C3 to C5 Aliphatic Hydrocarbons	10
C5 to C6 Aliphatic Hydrocarbons	10
C6 to C8 Aliphatic Hydrocarbons	10
C8 to C10 Aliphatic Hydrocarbons	10
C10 to C12 Aliphatic Hydrocarbons	10
C12+ Aliphatic Hydrocarbons	10
C6 to C8 Aromatic Hydrocarbons	10
C8 to C10 Aromatic Hydrocarbons	10
C10 to C12 Aromatic Hydrocarbons	10
C12+ Aromatic Hydrocarbons	10